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OF

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FOR

SPINAL CORD REMOVAL TOOL WITH ADJUSTABLE BLADES

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SPINAL CORD REMOVAL TOOL WITH ADJUSTABLE BLADES

Background Of The Invention

1. Field of the Invention

The present invention relates to tools for removing the spinal cord from carcasses.

2. Description of Related Art

Spinal cord removal tools are used in the processing of carcasses to remove the spinal cord from the spinal cord channel surrounding it. Complete removal of the spinal cord is difficult due to the many irregularities and protrusions in the bony channel that surrounds it. Accordingly, tools of this type must perform both a cutting and grinding action and may also be referred to as "spinal cord grinders." A related problem is the elongated spinal cord membrane, which tends to wrap around the shaft of motorized removal tools and interfere with operation of the tool and proper removal of the spinal cord.

One tool that addresses these problems in removing the spinal cord is seen in European Patent EP 0 890 313 B1, which uses a motor driven blade disk spinning inside a housing. The blade disk includes multiple spinal cord removal blades oriented perpendicular to the plane of the disk. The removal blades are spaced around the perimeter of the blade disk and project out from the housing on the working side as the disk spins. Each removal blade includes a front cutting edge, a left cutting edge and a right cutting edge.

The front cutting edges are rounded and project outward from the perimeter of the blade disk that supports them. The shape of the removal blades allows them to penetrate into the spinal cord channel to scrape and cut out the spinal cord as the blade disk spins. The operator guides the exposed perimeter of the spinning blade disk, with the protruding removal blades, into the spinal cord channel.

The side cutting edges on the removal blades cooperate with fixed side blades mounted on left and right sides of the housing to cut up the spinal cord membrane as it is brought into the tool. The fixed side blades are mounted at an angle to the spinning side edges of the removal blades and provide a scissors-like

cut to shear the spinal cord membrane and cut it into smaller pieces. A vacuum opening is located inside the tool near the side blades to remove the waste material

One difficulty with the tool shown in EP 0 890 313 B1 is the fixed location of the side blades relative to the side edges of the removal blades. Because the side blades are located a fixed distance apart, it is difficult to manufacture the tool. The removal blades must be ground so that their left and right side edges are exactly the same distance apart as the distance between the non-adjustably mounted side blades.

As the blades wear, it becomes desirable to sharpen them. However, sharpening must be completed without affecting the distance between the left and right side edges of the removal blades or the location of the cutting edges on the fixed side blades. When the side blades fail to shear the spinal cord membrane, it wraps onto the shaft of the tool. The tool must then be disassembled and cleaned and new blades must be installed.

Bearing in mind the problems and deficiencies of the prior art, it is therefore an object of the present invention to provide a spinal cord removal tool with side blades that are manually or automatically adjustable to move towards and away from the side edges of the removal blades to compensate for wear, changes due to sharpening or manufacturing tolerances.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

Summary of the Invention

The above and other objects, which will be apparent to those skilled in art, are achieved in the present invention, which is directed to a spinal cord removal tool for removing a spinal cord and spinal cord membrane from a carcass. The tool includes a motor, a housing, and a blade disk mounted in the housing. Multiple spinal cord removal blades are mounted around the perimeter of the blade disk, each removal blade having a front cutting edge, a left cutting edge and a right cutting edge. The motor spins the blade disk within the housing and a portion of the blade disk, is exposed on a working side of the tool.

The operator aligns the plane of the spinning blade disk with the spinal cord channel and brings the working side into contact with the spinal cord channel to begin the removal process. The shape of the removal blades allows them to enter the channel and remove the spinal cord and spinal cord membrane.

The blade disk spins between a left side blade and a right side blade. The side blades are mounted on the housing for motion towards and away from the left and right cutting edges of the spinal cord removal blades. A left side adjustment mechanism adjusts the left side blade relative to the left cutting edges of the spinal cord removal blades. A right side adjustment mechanism adjusts the right side blade relative to the right cutting edges of the spinal cord removal blades.

In a first embodiment the right and left side adjustment mechanisms are self-adjusting and provide a floating mount for the side blades. In this embodiment, the side blades are straight and always contact at least two edges of the removal blades. The side blades are urged towards the side cutting edges of the removal blades by one or more springs. The floating spring mounting of the side blades allows them to automatically compensate for any changes in the location of the cutting edges due to wear or sharpening.

In a second embodiment the right and left side blades are curved and are always in contact with at least three edges of the removal blades. Each side blade is preferably urged towards the facing side cutting edges of the removal blades by three springs, which provide three floating mounts for each blade. The additional curved length of the side blades and the additional contact with the side cutting edges of the removal blades provides more blade support and allows the tool to operate at higher speeds.

In a third embodiment of the invention the right and left side adjustment mechanisms comprises right and left side manual adjustment mechanisms, which include corresponding right and left side adjustment screws for moving the right and left side blades towards and away from the cutting edges of the spinal cord removal blades. Preferably, the side blades are straight and include a pair of adjustment screws, located at each end, with corresponding lock screws for locking

the adjustment after it has been set manually. The manual adjustment allows the clearance between the side blades and the removal blades to be very accurately controlled and adjusted for improved cutting performance, reduced blade chatter and low noise, particularly when the tool is operated at very high speeds.

Brief Description of the Drawings

The features of the invention believed to be novel and the elements characteristic of the invention are set forth with particularity in the appended claims. The figures are for illustration purposes only and are not drawn to scale. The invention itself, however, both as to organization and method of operation, may best be understood by reference to the detailed description which follows taken in conjunction with the accompanying drawings in which:

Fig. 1 is an exploded perspective view of a first embodiment of the spinal cord removal tool of the present invention.

Fig. 2 is a left side elevational view of an alternative design for a cutting head with curved side blades providing a second embodiment of the present invention. The cutting head of this embodiment may be driven by the motor and handle mechanism shown in Fig. 1.

Fig. 3 is a top plan view of the alternative cutting head of Fig. 2.

Fig. 4 is a left side elevational view of another alternative design for a cutting head with manually adjustable side blades providing a third embodiment of the present invention. The cutting head of this embodiment may also be driven by the motor and handle mechanism shown in Fig. 1.

Fig. 5 is a top plan view of the alternative cutting head of Fig. 4.

Fig. 6 is a cross-sectional view of the left side blade and the cover of the alternative cutting head of Fig. 4 taken along the line 6-6 in Fig. 4. The cross section extends only through the left side blade and the cover to which it is mounted, the opposite right side blade being substantially identical.

Description of the Preferred Embodiment(s)

Referring to Fig. 1, the present invention includes a motor 10 having a handle 12, a trigger 14 for operating the tool and hand guards 16, 18. In the preferred embodiment, the motor 10 is a pneumatic motor connected to a supply of pressurized air via air inlet 20. Air is exhausted through exhaust outlet 22. In other embodiments, the motor may be an electric motor or the tool may be hydraulically powered, if desired.

When trigger 14 is actuated, the motor 10 spins square shaft 24, which drives the blade disk 26 in rotary motion inside of housing 28. Cover 30 forms a part of the housing so that the blade disk 26 is exposed only along a front working edge extending outward from edges 32 and 34 of the housing 28.

The motor may drive different cutting heads, including the cutting head shown in Fig. 1 or the alternative designs shown in Figs 2-3 or Figs 4-6. In each embodiment illustrated, the blade disk 26 is identical and spins inside a housing having mounting holes for attachment to the motor and handle 10, 12. The housings are substantially identical except for the manner in which the side blades are mounted as described in detail below.

Square motor shaft 24 extends through opening 66 in housing 28, through washer 68 and into engagement with the blade disk 26. Cap screw 70 engages internal threads 72 in shaft 24 to hold the blade disk on the shaft 24.

Blade disk 26 is provided with multiple mounting surfaces 36 that are oriented perpendicular to the plane of the blade disk. Each mounting surface is provided with a mounting hole 38 for mounting a corresponding removal blade 40. In the preferred design shown, there are ten removal blade mounting surfaces equally spaced around the perimeter of the blade disk 26 for mounting ten corresponding removal blades 40. For clarity in the drawing, only one removal blade 40 is shown. Mounting screw 42 and nut 44 securely hold the removal blade 40 onto its corresponding mount.

Each removal blade 40 includes a front cutting edge 46, which is preferably rounded, a right side cutting edge 48 and a left side cutting edge 50. The right and

left side cutting edges are parallel to each other and are parallel to the plane of the blade disk when mounted thereon. The cover 30 of the housing is provided with a blade slot 52 on the left side of the cutting disk and the housing 28 is provided with a corresponding blade slot 54 on the right side.

Slot 52 receives the cutting edge 56 of a left side blade 58. Slot 54 receives the cutting edge 62 of a corresponding right side blade 60. The cutting edges 56 and 62 of the non-rotating side blades lie in a plane that is parallel to the side cutting edges of the rotating removal blades.

In contrast to the fixed side blade design of the prior art seen in European Patent EP 0 890 313 B1, the side blades 58 and 60 of the present invention are mounted so that they can move towards and away from the blade disk 26. Corresponding right and left side adjustment mechanisms allow the location of the side blades to be adjusted, either automatically or manually, relative to the cutting edges on the removal blades. In the design shown in Fig. 1, the right and left side adjustment mechanisms are floating, self-adjusting mechanisms that automatically adjust the location of the side blades.

Springs 64a-64d urge the side blades in towards the rotating removal blades to ensure that the cutting edges are always in contact. When they are in this normal cutting contact, the right side cutting edges 48 of the removal blades 40 and the right cutting edge 62 of the non-rotating side blade 60 lie in the same plane on the right side of the blade disk. Similarly, the left side cutting edges 50 of the removal blades 40 and the left cutting edge 56 of the non-rotating side blade 58 lie in a cutting plane on the left side of the blade disk.

As can be seen by comparing the angle of slot 54 to the axis of opening 66 in the right side of the housing, the right cutting edge 62 on the right side blade 60 extends at an angle to the right cutting edge 48 of the removal blade 40 in the right side cutting plane. The length of the cutting edge 62 is such that the right cutting blade edge is always in simultaneous contact with at least two of the side cutting edges 48 on the removal blades. This contact supports the right blade 60 against further inward motion under the pressure of right side springs 64c and 64d.

As the removal blades 40 wear, the right side cutting blade 60 progressively moves inward, always remaining in contact with the right side cutting edges of the removal blades. This self-adjustment feature significantly increases the time between blade changes as compared to the prior art designs. It also makes it much easier to resharpen the inner removal blades 40 or the outer side blades 58, 60 because the distance between the outer blades no longer needs to remain fixed.

The left side blade 58 operates in the same manner in cooperation with the left side cutting edges 50 of the removal blades 40. The floating mount of the left side blade 58 includes bearing openings 74 and 76, which slide on corresponding shafts 78 and 80. The shafts 78 and 80 mounted perpendicularly between a back support plate 82 and the housing cover 30 with attachment bolts 84 and 86.

Left side springs 64a and 64b are located around shafts 80 and 78 respectively. The perpendicularly mounted shafts 78 and 80 and the slide bearing openings 74 and 76 cooperate to keep the motion of blade 58 substantially perpendicular to the plane of rotation of blade disk 26. This design prevents the side blade from tipping. The multiple cutter contact between side blade edge 56 and the removal blades 40 cuts the spinal cord membrane into small pieces during each rotation with a scissors-like shearing action.

Two setscrews 88a and 88b threaded into corresponding threaded openings in the support plate restrict outward travel of the support plate 82. The setscrews extend through the plate 82 until their tips are close to the back surface of blade 58, but not in contact therewith. This allows the side blade 58 to float, but prevents it from moving fully outward to completely compress the springs 64a and 64b. This limitation on motion keeps the side blade cutting edge near to the side cutting edges 50 on the removal blades and cuts thick pieces of spinal cord waste material which might otherwise push the side blade 58 outwards. Once the setscrews 88a and 88b are adjusted, the adjustment is fixed by tightening nuts 89a and 89b on the setscrews.

The mounting of the right side blade 60 is substantially identical to the mounting of the left side blade and will not be described in detail.

A waste removal tube 90 is connected at end 92 to a source of vacuum to remove waste material as it is brought into the tool by the spinning blade disk and chopped with the action of the side blades. The inner end of tube 90 is open to the housing and is positioned near the point where the side blades shear the incoming spinal cord membrane.

Figs. 2-3 illustrate a second embodiment of the present invention. In this design the left and right side blades 100 and 102 are curved and are always in contact with at least three of the side cutting edges 48, 50 on the removal blades. This additional contact provides greater blade stability during high-speed operation and reduces the likelihood of blade chatter. The right and left side adjustment mechanisms for the curved side blades 100 and 102 are similar to the adjustment mechanism described in connection with the straight blades shown in Fig. 1 except that three mounts are used, instead of two, and the function of support plate 82 has been replaced by an enlarged head 104 on the mounting screws 106.

The left side adjustment mechanism includes three left side mounting screws 106 with corresponding left side springs 108. The left side mounting screws 106 are threaded into the cover 110 which includes a curved slot to receive the curved cutting edge of the left side blade 100. The curved cutting edge of the left side blade 100 extends perpendicularly in towards the plane of rotation of the blade disk 26 in the same manner as shown for the straight side blades in Fig. 1.

The enlarged head 104 on the left side mounting screws 106 traps the mounting springs 108 between the back side of the curved left side blade 100 and the enlarged head. The three left side springs 108 then urge the left side blade 100 towards the left side cutting edges of the removal blades 40.

The right side curved blade 102 is mounted to the housing 112 in the same manner as the left side blade is mounted to the cover 110. The housing 112 includes a corresponding curved slot to receive the curved cutting edge of the right side blade 102. Three right side mounting screws 114, which are identical to left side mounting screws 106, trap right side mounting springs 116 between their enlarged heads and the back of the right side curved blade 102.

The self-adjusting, floating, adjustment mechanism shown in Fig. 1 may also be used for the curved side blade design of Figs. 2-3 except that the support plates would be curved instead of straight.

Figs 4-6 show a third embodiment of the present invention in which the side blades 200 and 202 are straight, similar to the design in Fig. 1, but the right and left adjustment mechanisms hold the side blades in a fixed location, instead of allowing them to float as in the two previously described embodiments of the invention. The side blades in this design are manually adjustable towards and away from the side cutting edges 48 and 50 on the blade disk. This allows the side blades to be adjusted to minimize or eliminate any blade chatter during the highest operation speeds. It also helps to minimize blade noise resulting from contact between the side blades and the side edges of the removal blades during high-speed operation.

In this design the side blades 200 and 202 include internally threaded openings 204 that receive adjustment screws 206. The adjustment screws 206 are externally threaded to match the internal thread of openings 204 in the side blades. The adjustment screws 206 are also provided with a knurled enlarged portion 208 at the upper end so that the adjustment screw can be turned by hand.

The bottom ends of the adjustment screws on the left side rest against the cover 210. The bottom ends of the adjustment screws on the right side rest against the housing 212. Rotating the adjustment screws in a clockwise direction causes the side blade to move away from the side edges of the removal blade to increase clearance. Rotating the adjustment screws in a counter-clockwise direction causes the side blade to move toward the removal blade.

Each adjustment screw 206 includes a central bore that receives a corresponding lock screw 214. The lock screw extends through the central bore and into a corresponding threaded opening located in the cover 210 (left side adjustment screws) or housing 212 (right side adjustment screws). To adjust the side blades, the lock screws 214 and adjustment screws 206 are backed off until the side blade contacts the side edges of the removal blades.

The adjustment screws 206 at opposite ends of the side blades are then rotated clockwise until the base of the adjustment screw contacts the cover 210 (left side adjustment screws) or housing 212 (right side adjustment screws) below. Making an additional partial rotation of the adjustment screws lifts the side blade away from the side edges of the removal blades and gives the desired clearance. The lock screws are then tightened to hold the adjustment screws in the set position and maintain the desired clearance.

While the present invention has been particularly described, in conjunction with a specific preferred embodiment, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. It is therefore contemplated that the appended claims will embrace any such alternatives, modifications and variations as falling within the true scope and spirit of the present invention.

Thus, having described the invention, what is claimed is: